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long, arise as a rule from a protoplasmic prolongation at their base and pass without exception to the molecular layer, within which they divide into two branches running longitudinally and parallel to the surface; so abundant are these T-terminations in this region that a longitudinal vertical section of a folium shows a distinct longitudinal striation due to them.

Turning now to the *Nerve Fibres*: (a) The medullated fibres form a thick net-work in the granular layer, a thick band just below the cells of Purkinje, and bundles passing to the molecular layer between these cells. In the molecular layer they are abundant in the central portions and decrease towards the periphery. In this layer also they sometimes divide. (b) A portion of the fibres from the medullary layer are non-medullated, and end in part in the granular and in part in the molecular layer, and owing to the fewness of them in the latter locality they may be associated with the small peripheral nerve-cells of that region.

If the matter is looked at from the other side and we attempt to account for the nerve prolongations of the several groups of cells just described, we have the following:

Molecular Layer.—Cells of Purkinje, nerve prolongations medullated; (a) small peripheral cells, nerve prolongations not known; (b) basket-cells, nerve prolongations non-medullated. *Granular Layer*.—(a) Large nerve-cells, nerve prolongations non-medullated; (b) small nerve-cells, nerve prolongations medullated, giving rise to the bundles of nerve-fibres which pass between the cells of Purkinje and finally form the longitudinal striation of the molecular layer mentioned above(?) Nowhere is there seen anastomosis between the termini of cells or fibres either with themselves or with one-another, and the physiological relation remains therefore as much of a riddle as ever.

Zur feineren Anatomie des centralen Nerven-systems. Zweite Beitrag. Das Rücken-Mark. Taf. I—VI. A. KÖLLIKER. Zeitschr. f. Wissen. Zool., 51 Band, 1 Heft. Dec., 1890.

In this second communication Kölliker has formulated the new facts concerning the spinal cord much in the same manner as he has those for the cerebellum in the first communication just reviewed. The discoveries are the result of the application of Golgi's method to the nervous system of foetuses or very young animals and the chief authorities, as before, are Golgi and Ramon y Cajal. In the material from immature animals the nerve-fibres are non-medullated to a greater or less extent, and appear therefore to be more easily brought out by the silver method. The fact that many of the results thus far obtained have not been verified on the adult by this same method may be urged against the validity of the conclusion, but other methods used on the adult give so much confirmation to the results here described that there is great reason for considering them as generally true.

In the light of these investigations the spinal cord in man may be described as follows:

The *dorsal nerve roots* all arise from the spinal ganglia, enter the dorsal column of the same side and there sooner or later divide into two branches one of which runs cephalad, the other caudad. In some cases these longitudinally coursing fibres run for a distance in the foetus which would be equivalent to 4—6 cm. in the adult. In other cases they soon bend at right angles to the long axis and run into the gray matter, where they terminate. The criterion of termination is the formation of one or more finest branches, which in certain cases may amount to a bunch of terminals suggesting the "baskets of the baskets cells" in the cerebellum. In addition to these terminals there are those of an entirely new sort, formed by so-called "collateral fibres." These are very fine, arise more or less at right angles to the course of the main fibre, and appear too,

constantly abundant for these dorsal root fibres at least, and thus form a most important addition to the possible paths for incoming impulses. As many as nine of these collaterals have been counted running from a single fibre. The exact point in the fibre at which these collaterals arise in the adult is a matter of speculation. In the specimens described there appears to be a thickening of the fibre just at the point of origin, but the silver method does not offer any explanation of this appearance.

The dorsal roots pass to the dorsal columns and the gray substance of the same side, and to a small extent to the gray substance of the opposite, the crossing taking place mainly in the ventral commissure. The *efferent nerve roots* arise from the nerve prolongations of large and small cells in all parts of the ventral *cornua*, and in some cases give off at their origin a few branches. In many other cases no lateral branches are found, but the negative evidence in this case has little value. The ventral and lateral columns contain fibres which in part arise from cells situated at all levels in the cord. The great majority of fibres in these columns, if not all, give rise to collateral branches, which end freely in the ventral *cornua* and the ventral portion of the dorsal *cornua*. In many cases the fibres themselves of these columns bend at right angles and terminate as free fibres in the gray substance. The *ventral commissure* is composed, (a) of the nervous prolongations from cells in all parts of the gray matter which after crossing distribute themselves to the ventral and ventro-lateral columns, (b) of decussating collateral branches from the same columns, and (c) of decussating protoplasmic prolongations of some cells which lie close to the commissure. The *dorsal commissure* consists of (a) decussating collaterals of the dorsal root-fibres, (b) of possible decussation of collaterals from the dorsal portions of the lateral columns, and (c) doubtfully, of the decussation of the protoplasmic and nerve prolongations of a few cells lying near the central canal.

When the nerve-cells are classified on the basis of their nerve prolongations they fall into two groups: (a) Those whose nerve prolongation forms a fine net-work in the terminals of which it ends; and (b) those whose nerve prolongation maintains its identity, *i. e.* is directly continued into a nerve-fibre. Here again (b) a subdivision can be made into those that have nerve prolongations richly branched and those in which they are sparsely branched or not branched at all(?). When the cells are grouped according to the destination of the axis-cylinder they fall into: (a) Motor-cells where the nerve prolongation passes into motor nerve fibres and has the fewest lateral branches. (b) Those whose nerve prolongation passes into one of the columns of the cord and which may present almost any degree of branching. (c) Those whose axis-cylinder is much branched but in which the terminals are strictly confined to the gray matter of the cord. It will be noticed therefore that sensory cells in the older sense, are excluded from this list.

Passing by what may be said concerning the connective tissue elements we come to the physiological considerations connected with them. Those cells which directly give rise to nerve-fibres through their nerve prolongation alone act by continuity. In all other cases the relation between the nervous elements is that of contact simply, and constitutes an *actio in distans*. It was Golgi's view that the nerve prolongations ultimately formed a fine net work in which it was not so easy to see how an impulse should pick its way. The general outcome of Kölliker's discussion is that despite the great complication here present, there is a high degree of organization in this region and he rather swings back again to anatomical reasons for the reactions of the cord.